AN2165
Application note

ST10F27X Firmware Development
Getting Started with Keil µVision ST10 Toolchain

Introduction

This document provides an introduction to the Keil µVision toolchain (version 2) for the ST10F27x product family. It summarizes the different steps needed to configure the Keil development toolset, to build and to debug an application.

Although this application note cannot show all the topics relevant to the Keil tool, it demonstrates the first steps necessary to get started with the compiler/debugger.

Two very simple software examples are supplied with this application note. The first is a small application displaying a message on the toolset serial window. This example is used to show the required steps to create a project, build and debug it. The second example illustrates how to use interrupts and the Logic Analyser feature.

The application source files are provided within an archived file. This file can be unpacked into any directory.

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1 Keil ST10 toolchain

In order to start a project with keil toolchain, we need to perform the following steps:

- Edit / Project management: in this part, projects are created and maintained, project source files are edited etc.
- Build: here, a makefile (created by the Edit part) is used to invoke the needed toolchain components, resulting in an executable file.
- Debug: in this part, the executable file is used to debug the project.

Neither the toolset installation nor the license management are described in this application note. This section assumes that Keil is already installed on the development host.

For more details on Keil installation and licenses' management, refer to Keil documentation.

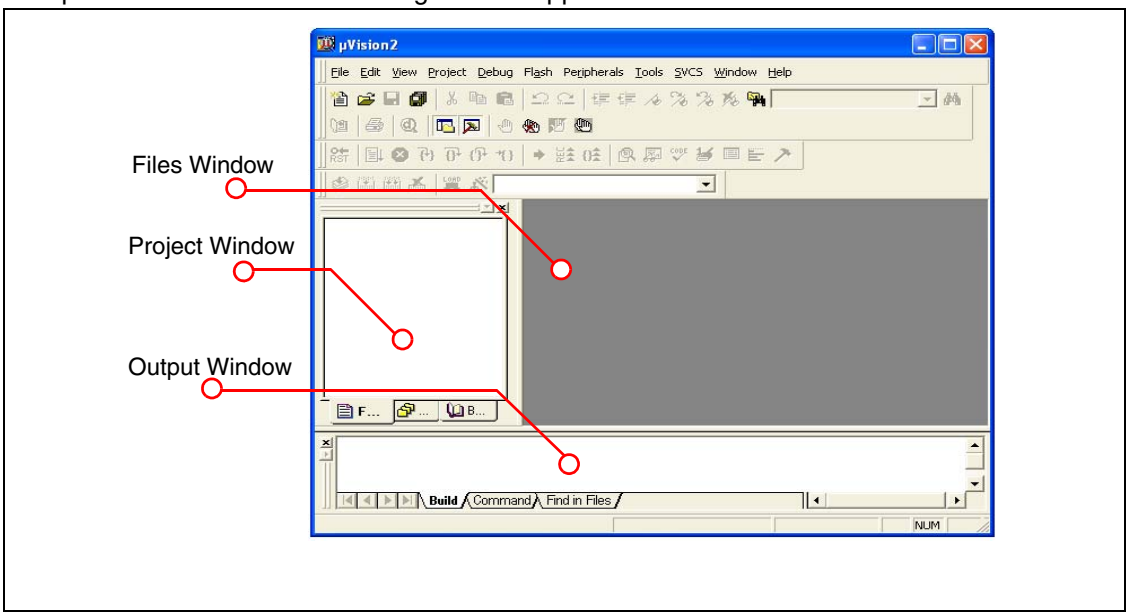
This section describes the steps required for creating, building and debugging an ST10F27x application using the Keil toolchain.

1.1 Starting Keil µVision Integrated Development Environment (IDE)

To select Keil toolchain:

- Select **Start -> Programs ->Keil µVision**.

Keil µVision starts and the following window appears:

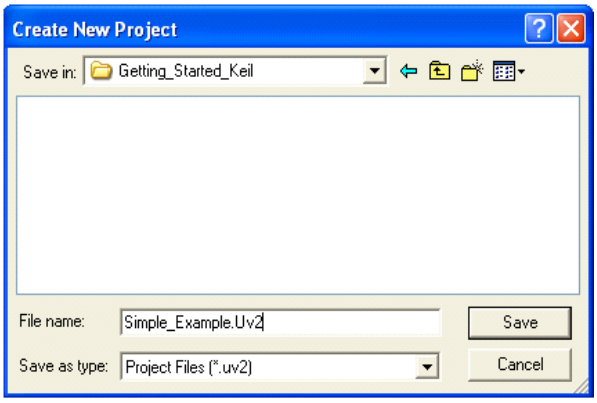


The Files window is used to edit source files. The project window contains several tabs for viewing informations about projects and other files. The output window contains several tabs to display results of EDE operations as compiles and builds.

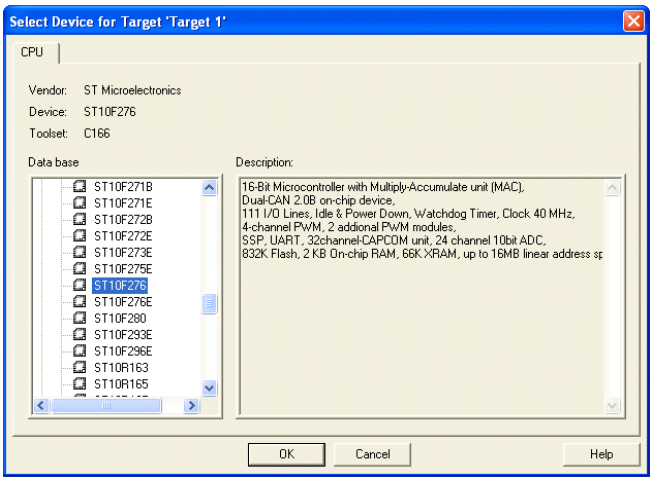
For further information about the windows contents, refer to the Keil documentation.

1.2 Creating a new project

- Select **New project** from the **Project** menu. This opens a Window dialog that asks you for the new project file name (see the figure below)
- Use the **Browse** button to select a working directory.
- Enter *'Simple_Example'* as the project space name in the **Filename** field.

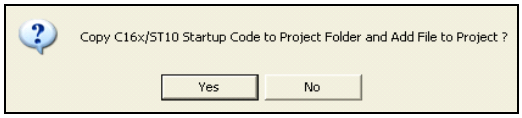


- Click **Save** to confirm your entry.
- The **Select Device for Target 'Target1'** window appears automatically allowing you to select a CPU for your project. This window shows the µVision device database. Select the ST10F27x MCU you plan to use. In this example, the ST10F276 microcontroller is used.



- Click **OK** to confirm your entry.

The following appears automatically:



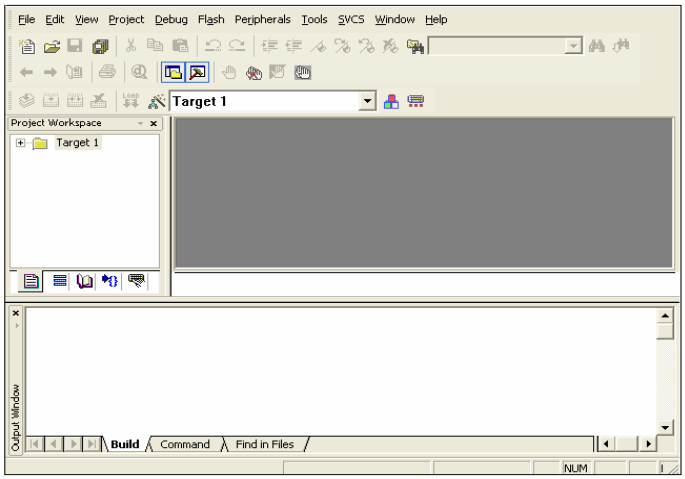
- Click **Yes** to confirm.

This window asks you to add the startup code to the project.

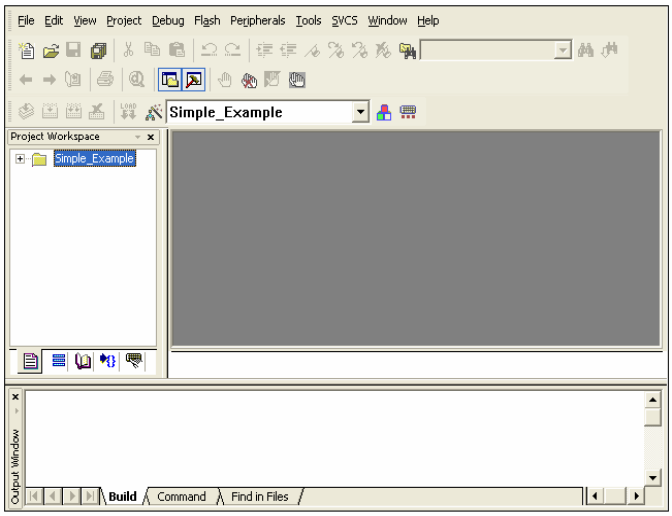
An ST10 program requires a CPU start up initialization code that is run just after a device reset. This start up code is used to set up the configuration of your hardware design and is written in assembly.

This file can be modified to match your hardware configuration.

The following figure appears:



- You can rename Target1 in the Project Window '*Simple_Example'* to improve readibility.



A project can have more than one Target. Creating another Target for a project means creating a project with the same source files. This is useful if you need a Target for testing and another Target for a release version of your application. If you also want to debug your application using two different configurations, you can use two Targets and each Target allows individual tool settings within the same project files.

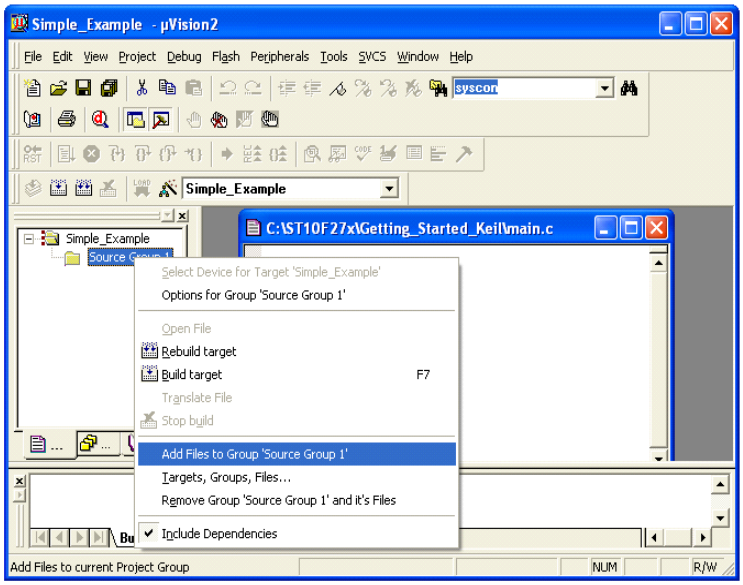
To add a new target, right-click on the project and select **Manage components**. From the window that appears, select **Project components** tab and click on the **New** button.

1.3 Adding files to the project

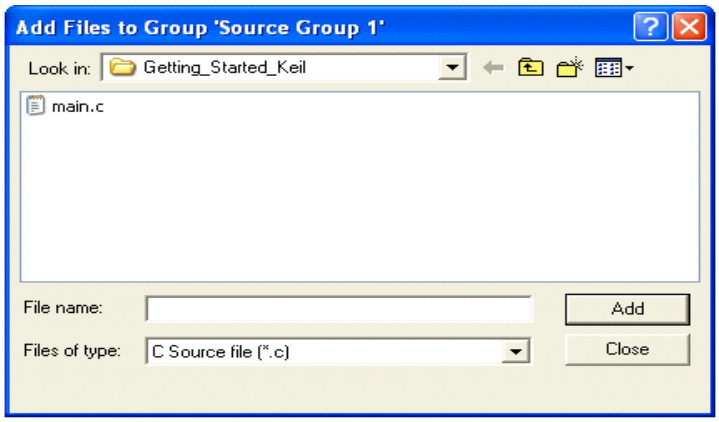
There are two ways to add source files to the project. Either the source file already exists in the working directory, in which case proceed as described in the *Section 1.3.1*, or new source files containing your own code are added as described in the *Section 1.3.2*.

1.3.1 Adding existing files

- Copy in your working directory the *'main.c'* file located in the folder *'Example1'* provided with this application note.
- Right-click on **Source Group 1** and select **Add Files to Source Group 1**



The following window appears:

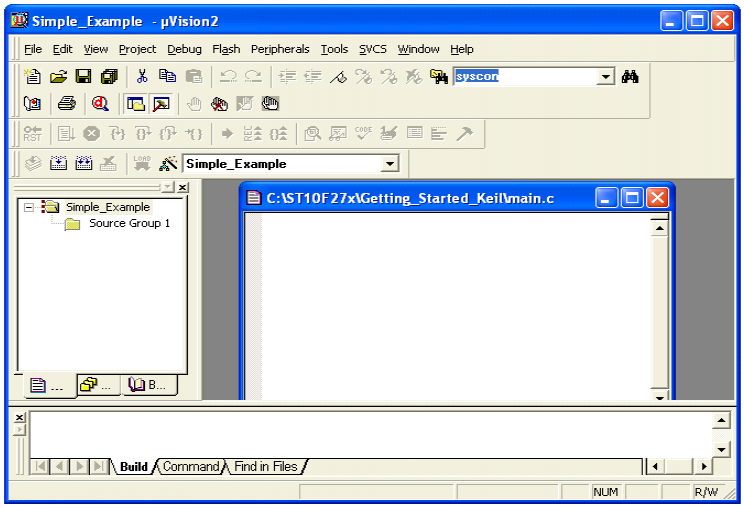


– Select *'main.c'* and click **Add** to confirm.

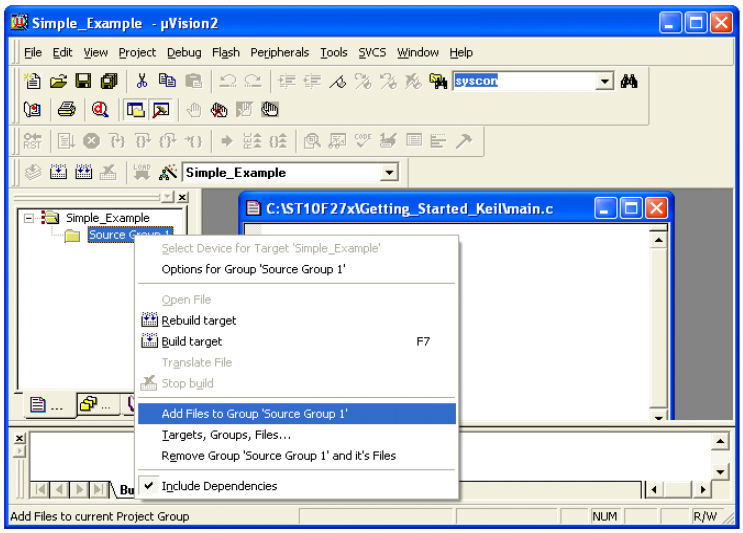
1.3.2 Adding new files

- You may create a new source file with the menu option **File - New.** This opens an empty editor window where you can enter your source code.

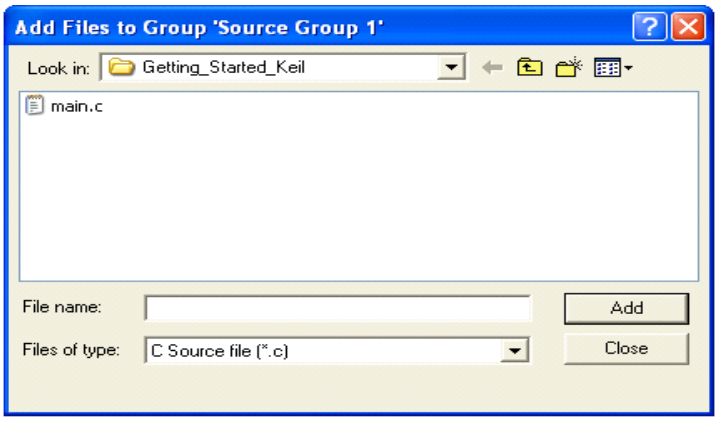
- Save the created file as *'main.c'*.



- Right-click on **Source Group 1** and select **Add Files to Source Group 1**



The following window appears:



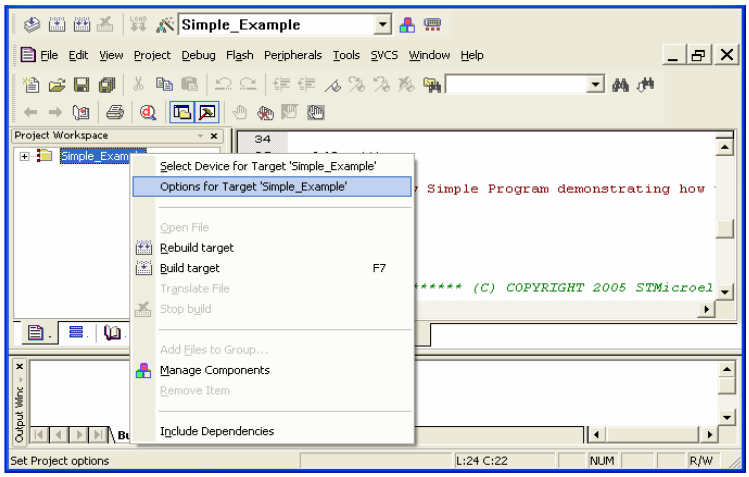
– Select '*main.c*' and click **Add** to confirm.

In this project, there is only one source file. If the application requires more than one source file and header file, you have to include them in the project in the same way as '*main.c* ' file.

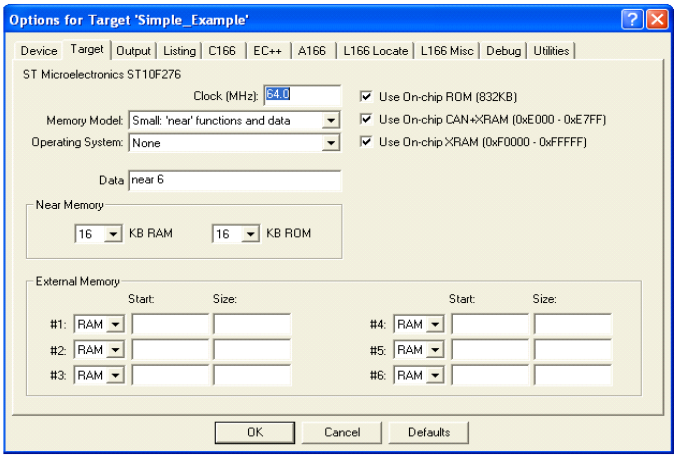
1.4 Setting build options

Before building your project, you should specify compiler and linker options. This section will present the most important options to be set.

- Right click on '*Simple_Example*'
- Select **Options for Target 'Simple_Example'**



The **Options for Target 'Simple_Example'** dialog appears.



This dialog contains several tabs to configure the project parameters.

1. Device

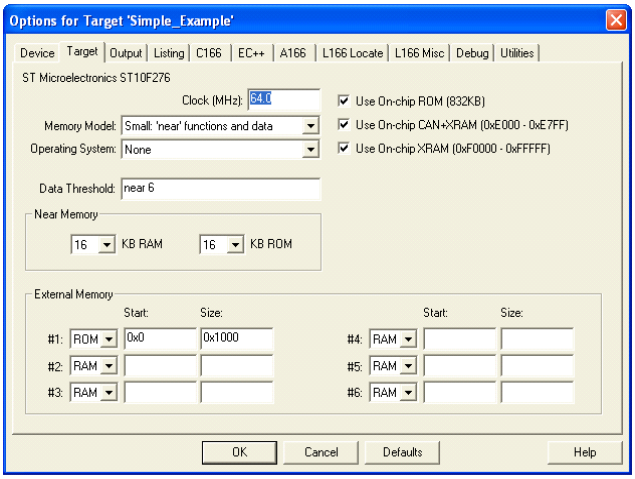
   On the Device tab, you can select the ST10F27x device you want to use as mentioned in *Section 1.2*.

2. Target

   On the Target tab, you need to:

– Specify the ST10F276 operating CPU frequency, for example 64Mhz.

– Fill the **External Memory** field with your external memory device address on the external bus. It is not mandatory to enter the location of the internal memory.



– Select the memory model. The memory model defines the default variable and function location and their default pointer size. The right selection depends on the application and impacts the compiler efficiency.

There are 7 memory models: Tiny, Small, Compact, Hcompact, Medium, Large, Hlarge. The Small memory model is used by default.

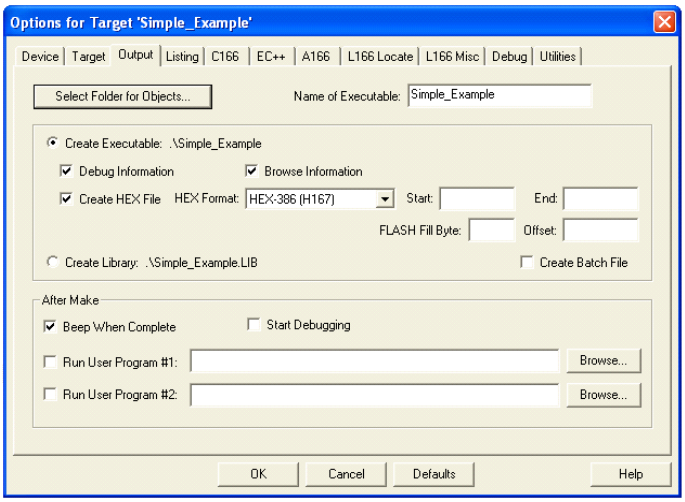
The memory models with their characteristics are represented in the following table:

Memory models	Characteristics
Tiny	All code and data must be within the first 64K. All function calls must be within the same segment.
Small	Code size is limited to 64K and data is limited to 16K for variables and 16K for constants. Using the `far` and `huge` keywords in data declarations can expand the overall data size to any size.
Medium	Code size is unlimited and data is limited to 16K of variables and 16K of constants. Using the far and huge keywords in data declarations can expand the overall data size to any size.
Compact	This model is the opposite of Medium. It is useful for programs with small amounts of code but a large data group.
Large	This models treats both function calls and data objects as FAR.
HLarge	This model is only available with MOD167. HLarge is the same as Large but the default for variable declarations is HUGE.
Hcompact	This model is only available with MOD167. Hcompact is the same as Compact but the default for variable declarations is HUGE.

For more details about memory models and choice criteria, please refer to Keil documentation.

3. Output

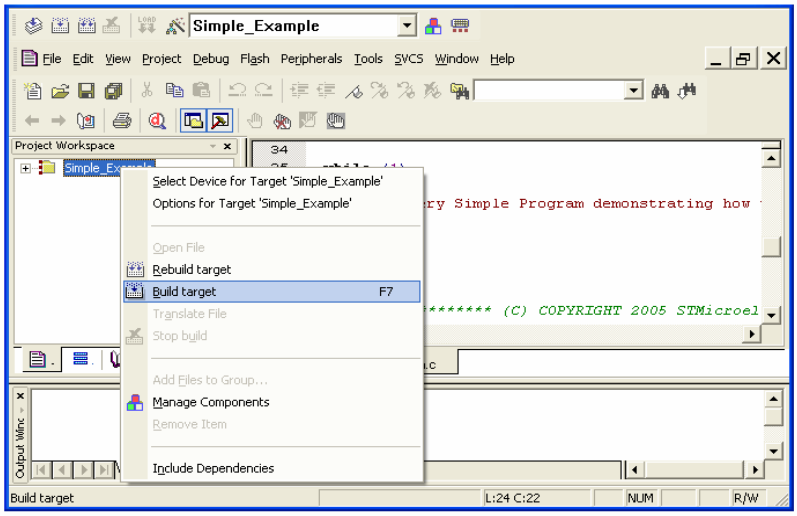
In this tab, you can select the format of your output file. For example, for HEX format, select **Create HEX File**.



For more details about Tool options, please refer to Keil documentation.

1.5 Building the application

The project has been configured. You can now build it by selecting **Build Target**



µVision will display errors and warning messages in the **Output Window-Build** page. A double-click on a message line opens the source file on the correct location in the µVision editor window.

When building the application successfully, many files will be generated automatically and placed in the working directory.

1.6 Debugging the application with Keil µVision debugger

Keil µVision debugger provides a high level interface between the user and a program running in the target system (execution environment).

Debugging the application requires that you have successfully compiled and built your application.

The µVision debugger offers two operating modes:

- Simulator : allows the configuration of the µVision debugger to simulate most features of the ST10F27x family without actually having target hardware. You can test and debug your embedded application before the hardware is ready.
- Debug on a hardware target: using for example Monitor 166 which is a program that resides in the external RAM memory of your target hardware. In this case, Keil µVision debugger runs on a PC computer and is connected to the ST10F27x target microcontroller via RS232 interface.

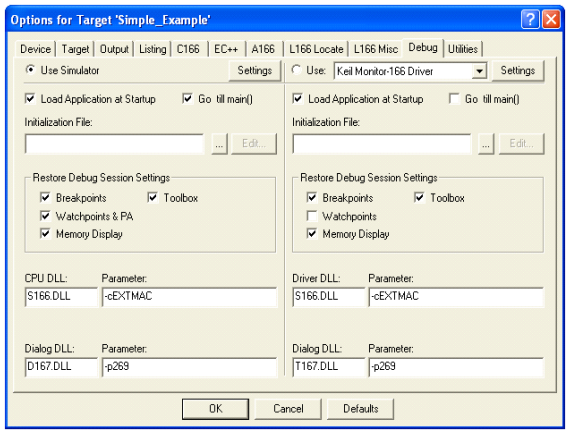
The monitor requires an external RAM memory to run. This RAM memory must be selected at reset.

When using this mode, the following requirements should be taken into account:

- External RAM chip select should be active
- Enter the bootstrap loader mode by forcing P0L.4 to 0 at reset
- The **Debug** tab in **Options for Target 'Simple_Example'** dialog configures the µVision debugger.

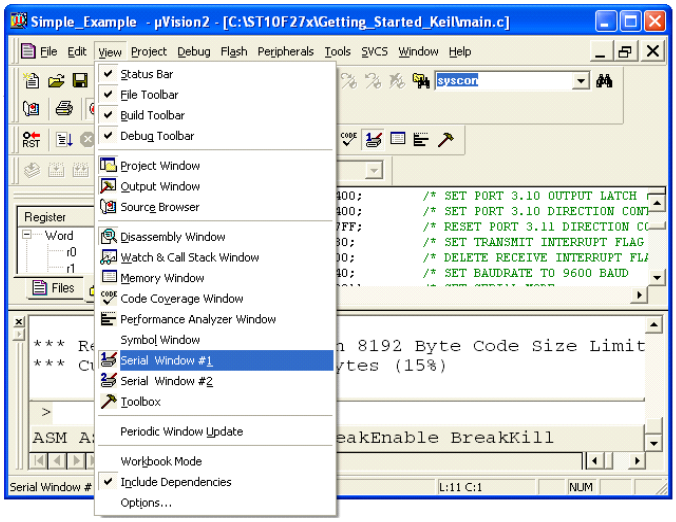
The simulator is used in this example by simply selecting **Use Simulator**.

This is illustrated in the following figure:

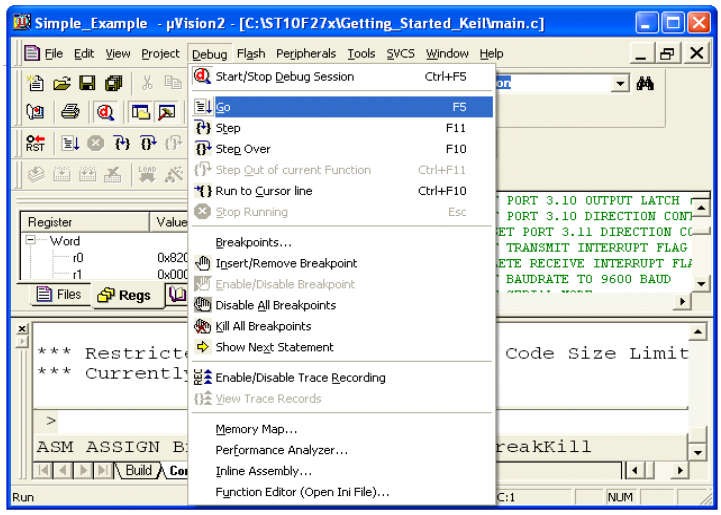


Select **Debug -> Start/Stop Debug session** from the menu toolbar in order to start debugging the application.

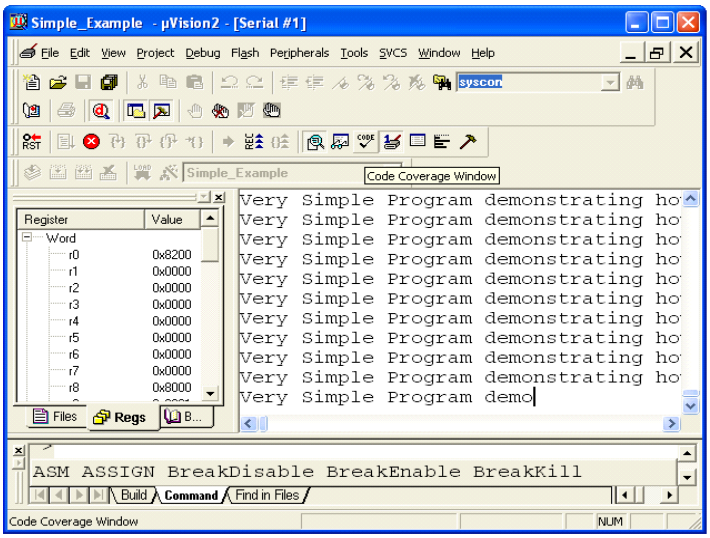
µVision provides more than one serial window for serial input and output. **Select View -> Serial Window #**



Select **Debug -> go** from the menu toolbar:



If everything is working properly, the following message appears on the serial window in an infinite loop



You can use breakpoints to run the application step by step. The memory and register contents can also be displayed.

For more details about µVision debugging features, refer to the Keil µVision documentation.

2 Application example: interrupt handling

This section describes a simple ST10F27x software example making use of the interrupts. The application uses Timers' overflow interrupts to generate two square signals with different frequencies on two standard port pins: P2.0 & P2.1.

The project contains 3 source files:

- Timer.c: It contains c source code for the following project routines
  - *Configure_GPT1_Timer_2()*: In this routine, GPT1 Timer 2 is set up to operate in Timer mode and is configured to generate an interrupt every 1.678 seconds.
  - *Configure_GPT1_Timer_3()*: In this routine, GPT1 Timer 3 is set up to operate in Timer mode and is configured to generate an interrupt every 104.8 milliseconds.
  - Timer 2 and Timer 3 interrupts' definitions: Timer 2 interrupt is toggling P2.0 while Timer 3 interrupt is toggling P2.1.
- Timer.h: It contains Timer.c routines prototypes.
- main.c: It uses the routines described in Timer.c in order to start the two timer overflow interrupts.

Timings suppose that the chip is operating at a frequency of 40 Mhz.

The environment has been setup as described in the first chapter.

For more details about the timers' functionalities, their registers and interrupts' handling, refer to the ST10F27x user's manual.

2.1 Debug operation

After successfully building the program:

- Select **Debug -> Start / Stop Debug Session** from the toolbar menu.

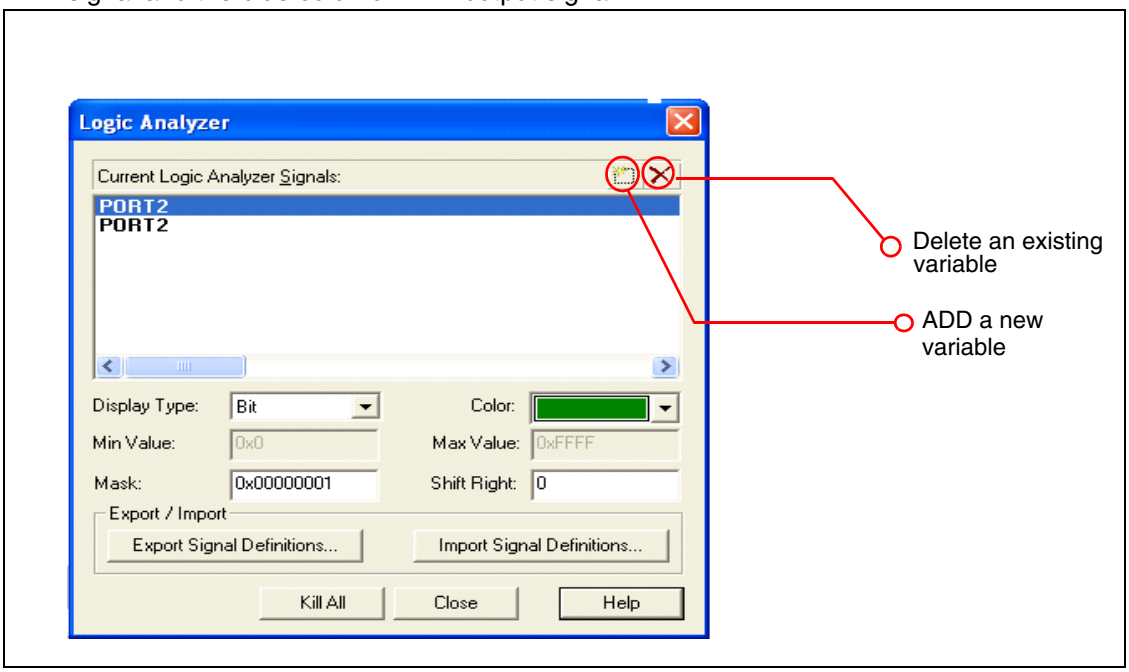
Port 2 output signals can be displayed using the **Logic Analyser** feature provided by Keil. This feature is available only on simulation mode.

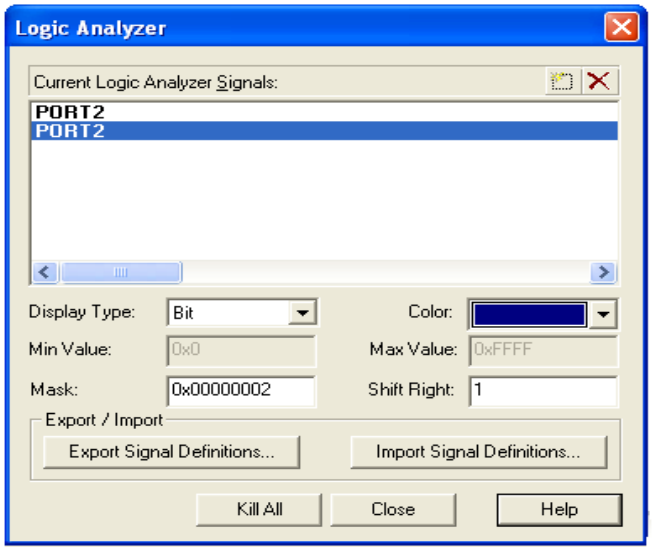
In order to view the port 2 content, select **Peripherals -> IO Ports -> Port 2** from the toolbar menu.

2.2 Logic analyser use

- Select **View -> Logic Analyser Window** from the toolbar menu of the debug window.
- Select **Debug -> Logic Analyser** from the toolbar menu
- Enter the variable that you want to visualize: *Port 2 pin 0* and *Port 2 pin1.*
- Precise the **Mask** to indicate if the signal corresponds to P2.0 or P2.1.

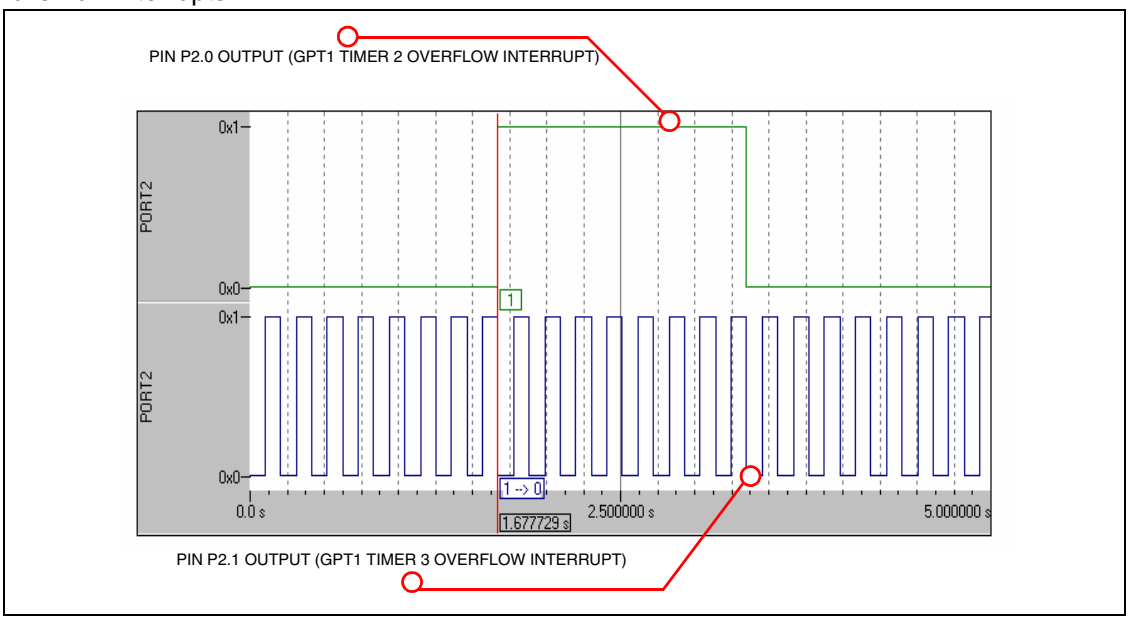
- Choose a color for each output signal. For example, choose the green color for P2.0 output signal and the blue color for P2.1 output signal.





- Click **Close** to confirm your entries.
- Select **Debug -> Go** from the toolbar menu.

The figure below shows the behavior of the port 2 pins 0 &1 and the GPT1 Timer 2 & Timer 3 overflow interrupts.



The example source code is located in the *'Example2'* folder provided with this application note.

For more details about the timers' functionalities, their registers and interrupts' handling, refer to the ST10F27x user's manual.

3 Revision history

Table 1. Document revision history

Date	Revision	Changes
30-Jun-2006	1	Initial release.

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